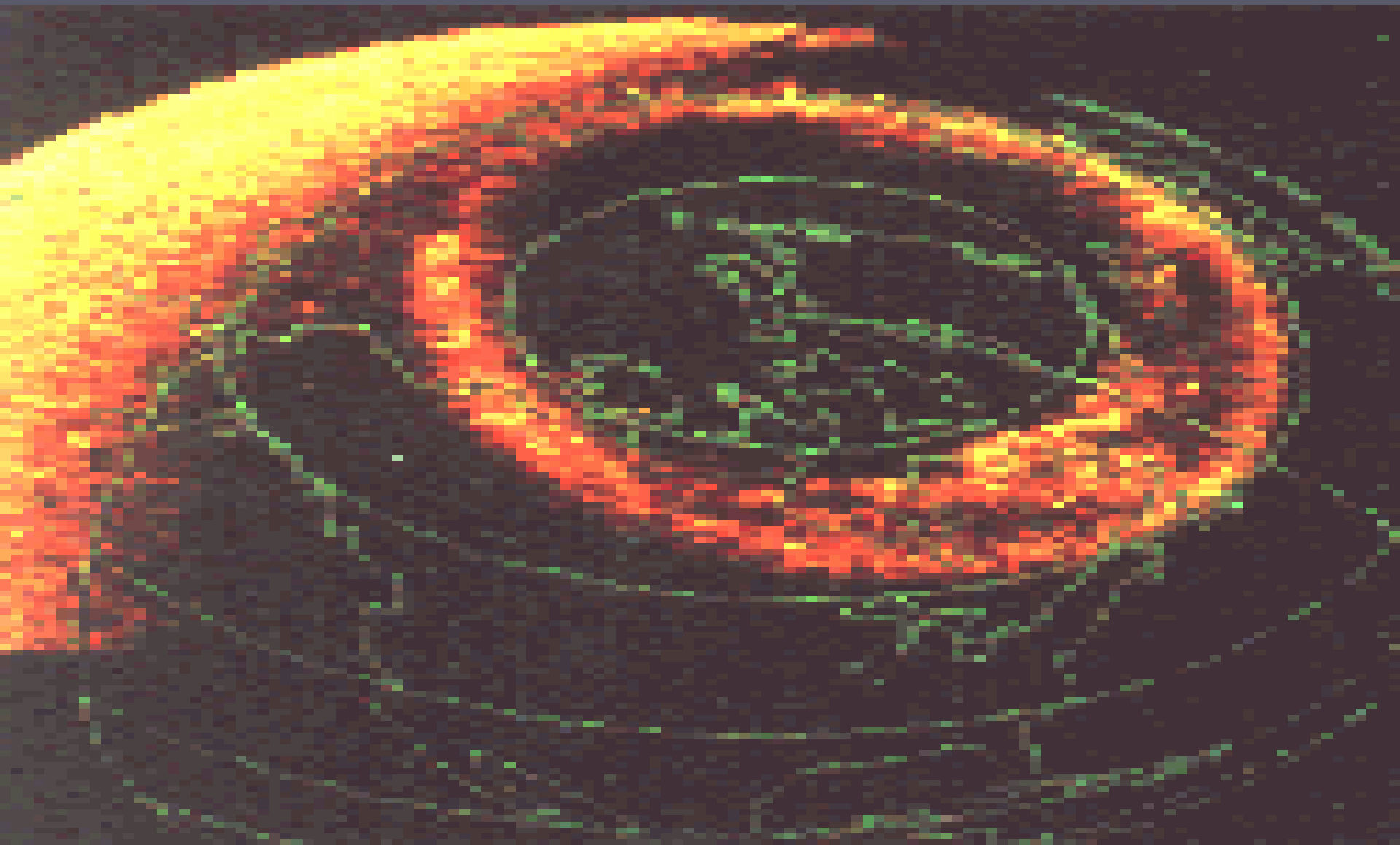


Cosmic Rays

NASA Image



Sources

- ▶ *Science Power 9* text
- ▶ NASA images
- ▶ Microsoft Clip Art
- ▶ Internet sites (with links)
- ▶ Slide 4 - Georgia A. de Nolfo
from PPT *Cosmic Rays*, for *Elements 2002*
Workshop, NASA
- ▶ Mike Muise; Mark Power (consultation)

Cosmic Rays

What Are they?

NASA site:http://imagine.gsfc.nasa.gov/docs/science/known/cosmic_rays.html

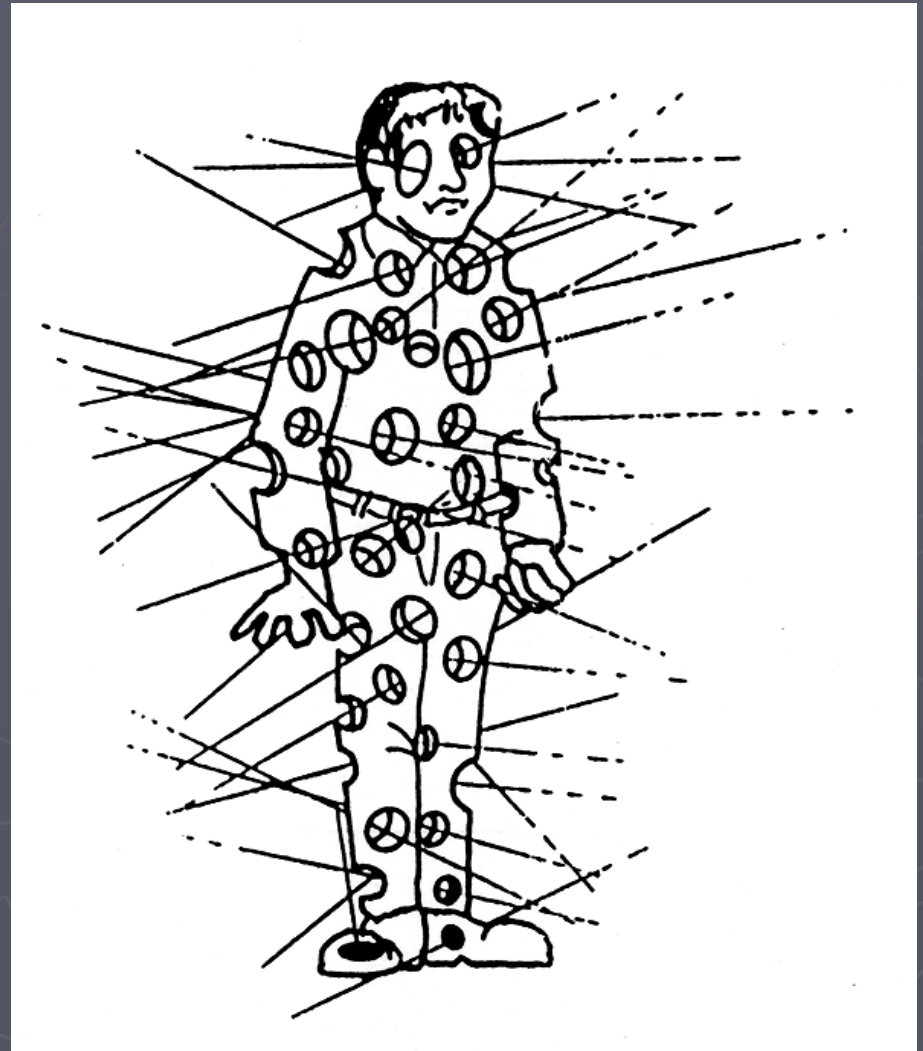
► What are they?"

- Cosmic Rays: High energy particles that bombard the earth.
- They travel at nearly the speed of light (RA Mewaldt: http://www.srl.caltech.edu/personnel/dick/cos_encyc.html)
- They strike the earth from all directions.
- GRC's (Galactic Cosmic Rays) are mostly pieces of atoms (nuclei + high energy electron, positrons and other subatomic particles)

Cosmic Rays on Earth

Slide created by **Georgia A. de Nolfo**
from PPT *Cosmic Rays*, for *Elements 2002 Workshop*

► **Cosmic Rays continually bombard the Earth. In fact, about 100,000 cosmic rays will pass through a person every hour!**



Cosmic Rays in Our Lives

► Weather:

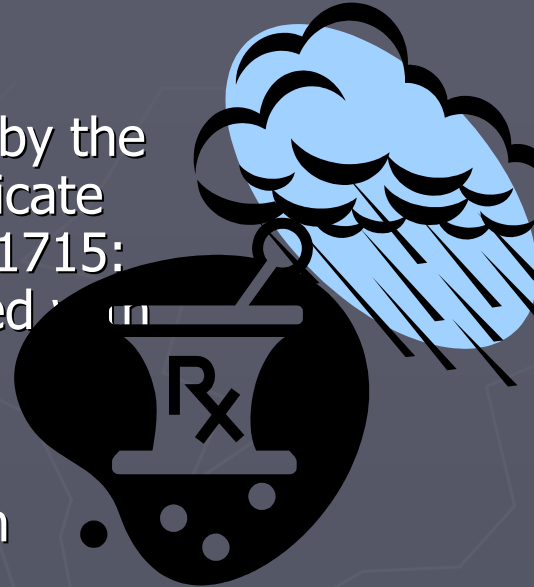
- Weather is influenced by the Sun. Cosmic Rays indicate Sun activity. (1645 – 1715: Little Ice Age correlated with little solar activity)

► Computers

- Cosmic Ray strikes can change basic units of memory

► Health

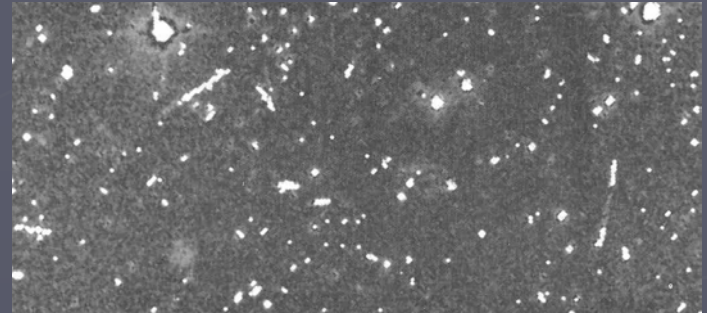
- Some risk of cellular damage to some people



Cosmic Rays in Our Lives

► Astronomy Research

- In addition to health risks to astronauts, image interference takes place (image from NASA at above linked site)



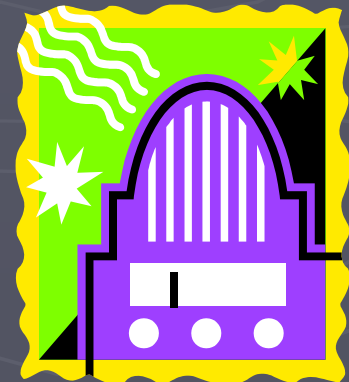
► Radio Communications

- Increased solar activity = increased # of ions = absorbed radio waves = raised noise floor, and interference with radio transmission



► Corroded Pipelines

- Affect electrical changes in deep-earth currents, causing corrosion to pipelines



Cosmic Rays in Our Lives

► Power Outage

- 1989: Massive blackout – Quebec Hydro

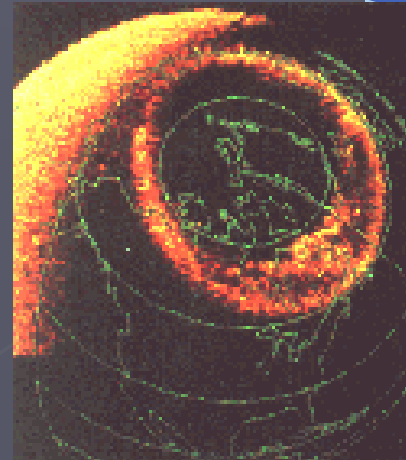
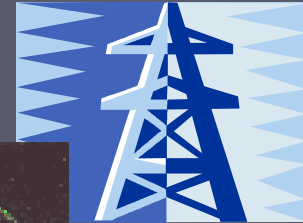
► Carbon Dating

- C-14 is produced from collisions between cosmic rays and carbon atoms

► Aurora Borealis (Northern Lights)

- Cosmic Rays which penetrate the magnetic field of Earth are guided toward the Polar Regions.
- Nitrogen and Oxygen ions in the atmosphere react with charged particles from the solar winds, producing lights/colours
- Images from:
<http://www.geocities.com/CapeCanaveral/Campus/8682/aurora.htm>
- And NASA
<http://sohowww.nascom.nasa.gov/explore/links.html>

► Aurora Video



Cosmic Rays

Where Do They Come From?

► Where do they come from?

- Galactic Cosmic Rays come from far away in the Galaxy.
 - Blast waves of Supernova explosions that gain energy and cannot be held. They escape into the Galaxy.
- Ultra-high energy particles come from outside the Galaxy. We do not know exactly how they are formed.
- Sunspots are the source from which high energy electrons and protons leave and penetrate the magnetosphere of the Earth.
- ACE – Advanced Composition Explorer
- Investigations of the origin and evolution of solar and galactic matter

Acceleration

- ▶ The acceleration is a one-time thing, created by an explosion.
- ▶ The motion is analogous to a bullet.
- ▶ A simulation was created for us by

Mark Power

(Park View Education Centre, Bridgewater, Nova Scotia, Canada. }

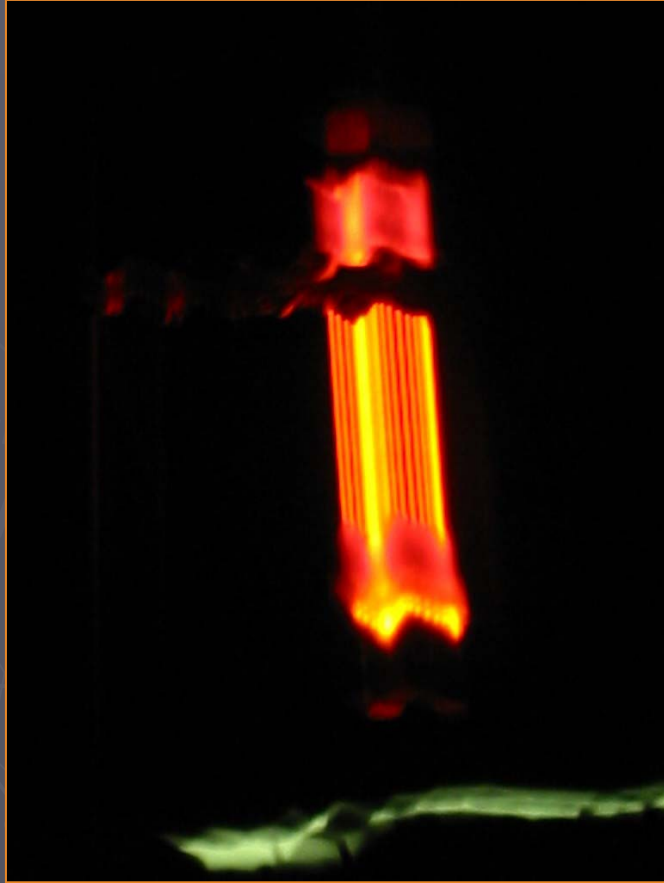


Accelerated Particle Presentation

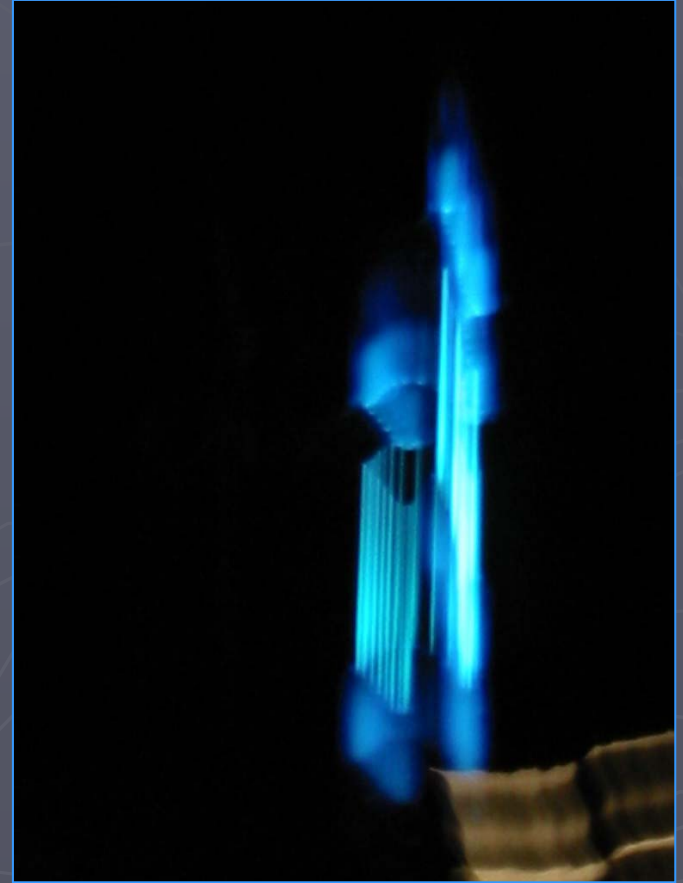
- Tubes are filled with particular gases, in this case, neon and mercury.
- In a dark room, a voltage (1000 v battery) was applied.
- Electrons were accelerated through the gas, causing collisions, and light.



Accelerated Particle Presentation - Resulting Lights



Cosmic Rays



Shirley J. Burris

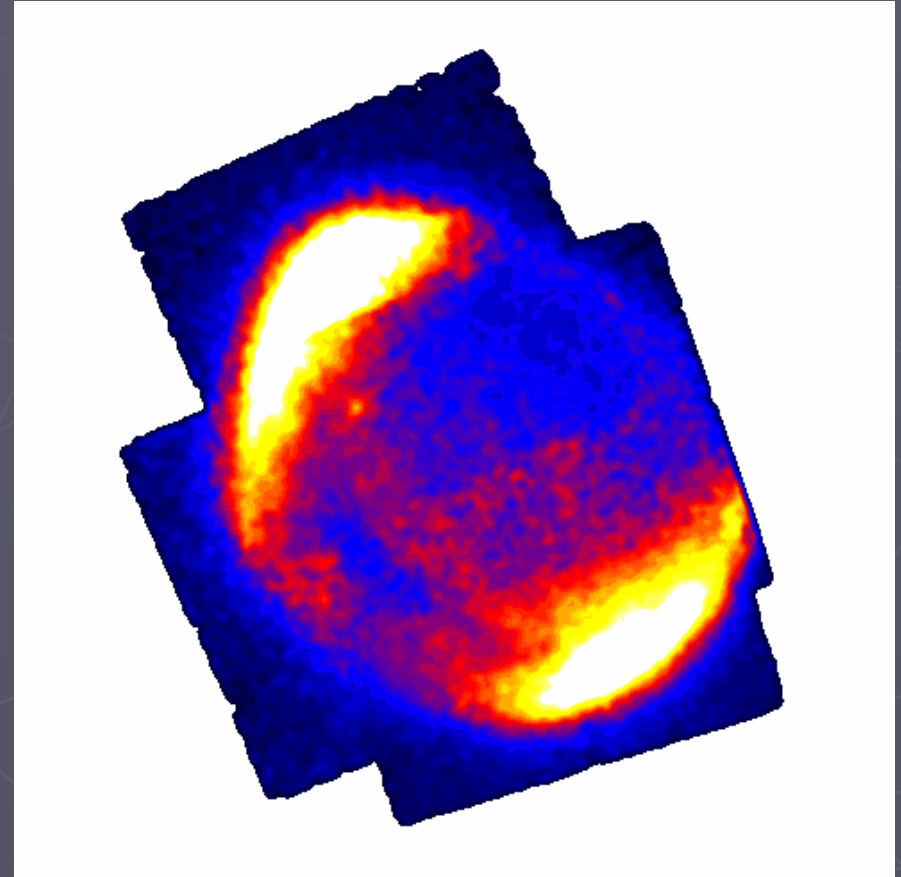
Cosmic Rays

What Are They Made Of?

- ▶ Mostly pieces of atoms
 - nuclei +
 - high energy electrons, positrons and other subatomic particles)
- ▶ Cosmic rays contain all the natural elements in the periodic table.
 - 90% hydrogen
 - 9% helium
 - 1% rest of the elements + “very rare elements and isotopes” (from NASA site)

Image from

<http://antwrp.gsfc.nasa.gov/apod/ap961016.html>



Your Own Investigations

- ▶ Cosmic Ray Applet
- ▶ Accelerate a particle!
- ▶ Click the poster to go to the Fermi National Accelerator Laboratory – take their virtual tour and find this poster among the sights.
- ▶ Have fun!

